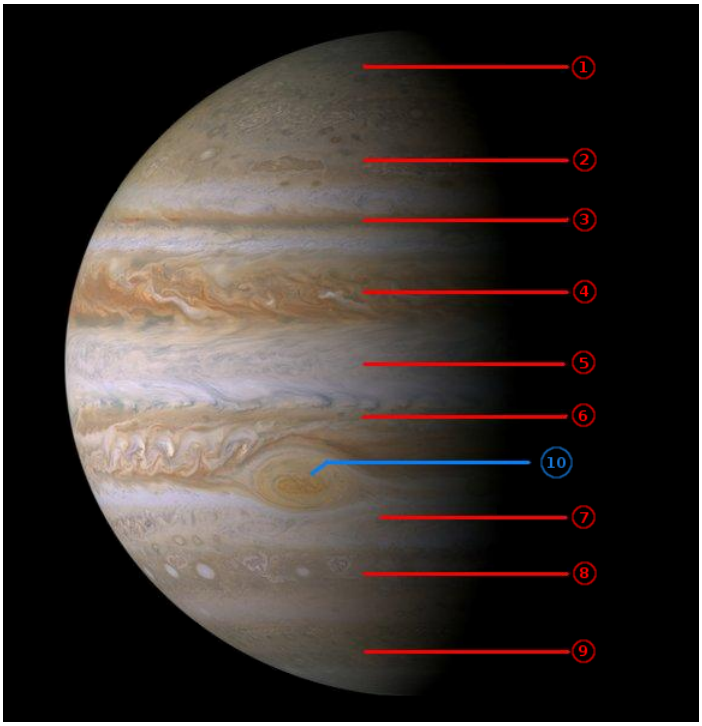
11.1: Jupiter's Atmosphere

Jupiter is known for its multi-colored bands. The atmosphere of Jupiter has **bright zones** and **dark belts**. The zones are cooler and are higher than belts. A stable flow of gases underlies the zones and bands, called **zonal flow**. Cooler gases sink in the atmosphere, creating the dark belts while warmer gases rise, creating the lighter zones. Different compounds in atmosphere produce clouds of different colors. For example, ammonium sulfide clouds (NH_4SH) reflect red/brown while ammonia in the highest, coldest layer, reflects white. Because Jupiter does not have a solid surface, when modeling its atmosphere, astronomers take the top of the troposphere as the 0 km mark and then map all positives based on how far above or below that mark they are.



Jupiter's belts and zones.

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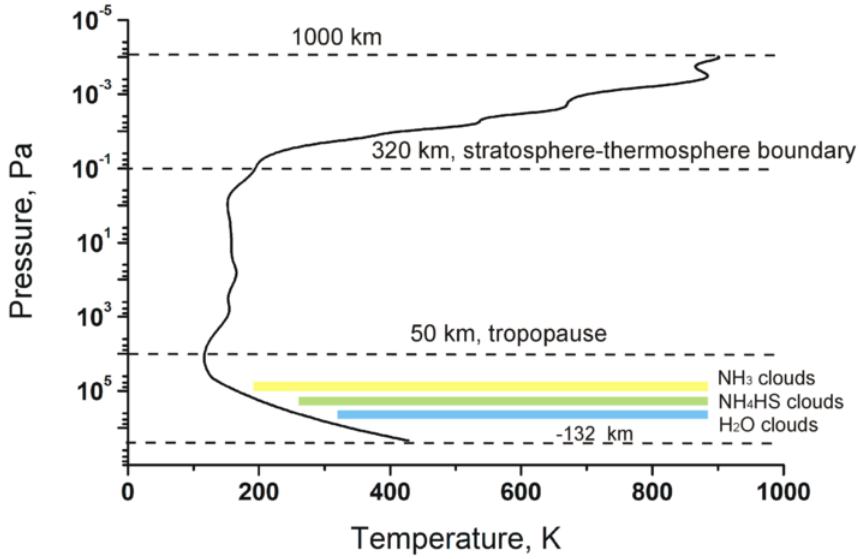

Structure of Jupiter's atmosphere.

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The composition of Jupiter's atmosphere is as follows:

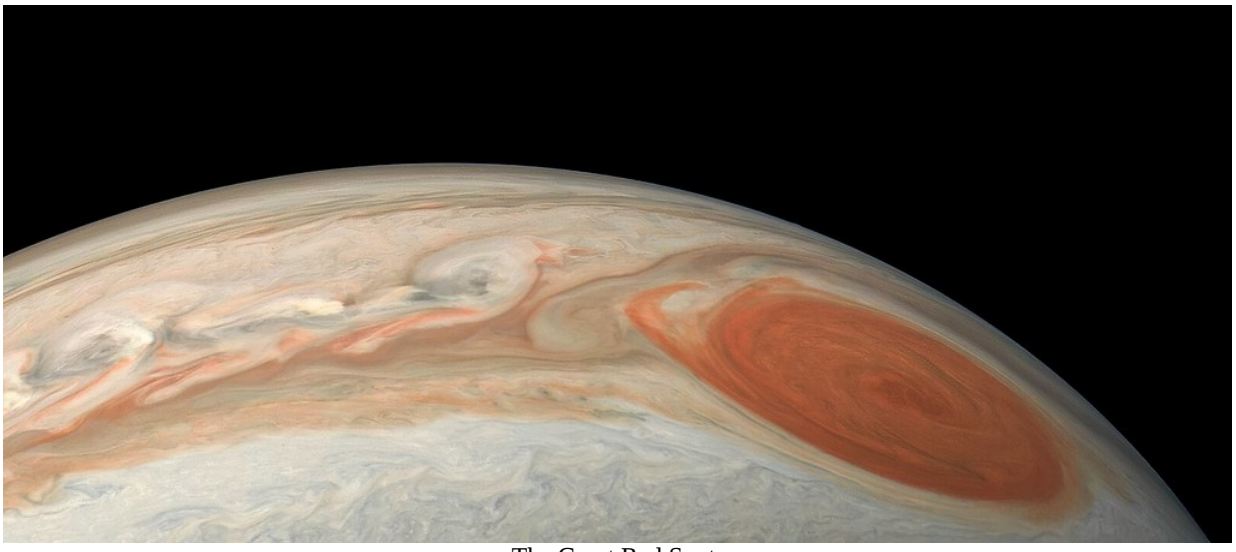
- 89.8% Hydrogen (H_2)
- 10.2% Helium
- ~0.3% Methane
- ~0.026% Ammonia
- ~0.003% Hydrogen deuteride (HD)
- 0.0006% Ethane
- 0.0004% water
- Ices on Jupiter include ammonia, water, ammonium, hydrosulfide(NH_4SH)

In December of 1995, the Galileo probe entered Jupiter's atmosphere and collected data for 57 minutes. The data from the probe revealed Jupiter's atmosphere had roughly the same percentage of hydrogen and helium as the Sun. The Galileo probe also found that Jupiter appears to have more carbon, nitrogen, sulfur, and other heavy elements, than the Sun. It is likely that these elements may come from interplanetary bodies like comets and asteroids that strike Jupiter. The Galileo probe found few organic molecules.

Hydrogen compounds in Jupiter form clouds. Different cloud layers correspond to freezing points of different hydrogen compounds. These cloud layers include, in descending order, ammonia (40-50 km below the top of the troposphere), ammonium hydrosulfide (60-70 km below the top of the troposphere), and water (~100 km below the top of the troposphere). Jupiter's lowest

cloud layer cannot be seen by optical telescopes. Measurements taken by *Galileo* probe show high wind speeds even at great depth. These are likely due to heating from the interior of the planet instead of from the Sun.

Jupiter's most striking feature is the Great Red Spot. This storm system is twice as wide as Earth. It is at least three centuries old as astronomers first noted its existence three hundred years ago and it is still there. Unlike on Earth, where hurricanes lose energy as they pass over colder water or make landfall, Jupiter's lake of a solid surface produces instabilities that can last for centuries.



The Great Red Spot.

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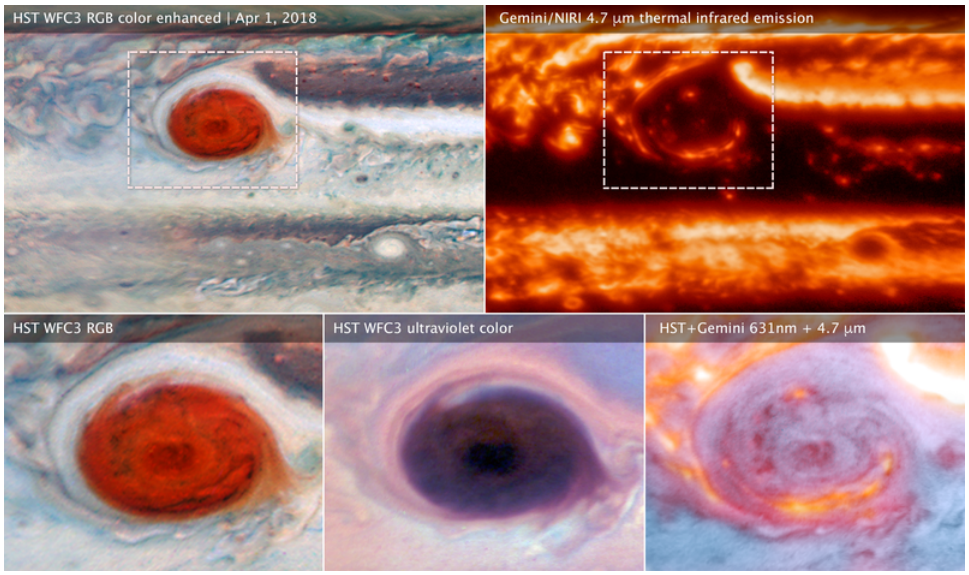

The Great Red Spot in various wavelengths.

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